Fuzzy algorithm to Mitigate Risk in the Assignment of Roles in a Wireless Network

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Abstract

This paper is presenting a method of defining a fuzzy membership function which helps in role assignment for wireless network. There is a risk involved in assigning roles dynamically as there can be a false negative or in other words an intruder is permitted into the system. The present proposal addresses this issue to mitigate the risk involved and overcome the false negative and false positive issues involved in assigning the roles.

Key words: Fuzzy membership functions, Trapezoidal Function, Crisp set, Full access, restricted access, Access denied

1. INTRODUCTION

The trapezoidal distribution is defined by minimum, lover mode, upper, and maximum parameters. The generalized trapezoidal distribution adds three more parameters: the growth rate decay rate and boundary ratio parameters. Van Dorp and colleagues formally describe the generalized trapezoidal distribution, representing the minimum lower mode, uppermode, maximum, growth rate, decay rate and boundary ratio with parameters a, b, c, d, m, n and α is given by

$$Fx(x|\theta)=C(\Theta)X\begin{cases}\alpha\left(\frac{x-a}{b-a}\right)^{m-1} & \text{for } a\le x<b\\ (1-\alpha)\left(\frac{d-x}{d-c}\right)^{n-1}+\alpha & \text{for } b\le x<c\\ \left(\frac{d-x}{d-c}\right)^{n-1} & \text{for } c\le x<d\end{cases}$$

With normalizing constant C(Θ) defined as

$$C(\Theta)=\frac{2mn}{2\alpha(b-a)n+(\alpha+1)(c-b)mn+2(d-c)m} \quad (1)$$

And where the parameter vector Θ={a, b, c, d, m, n, α}, a≤b≤c≤d, and m,n,α>0.

The trapezoid package provides functions for the probability density function(dtrapezoid), cumulative distribution function(ptrapezoid), quantile function(qtrapezoid), and random generation(rtrapezoid). The parameters a,b,c,d,m,n and α are specified by the arguments min,mode1, mode2, max,n1, n3, and alpha respectively. The argument names were chosen to avoid conflicts with names that commonly have specific meaning in R functions, such as c and n. [1]

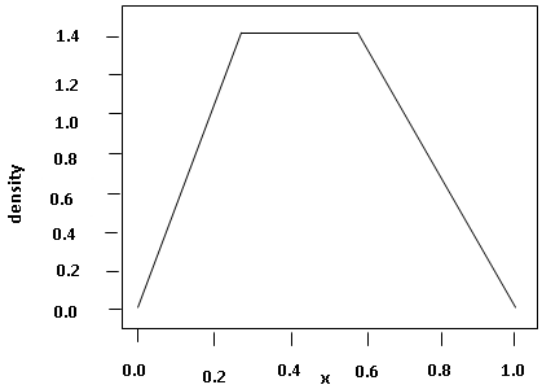

Figure:1 Trapezoidal Distribution function.

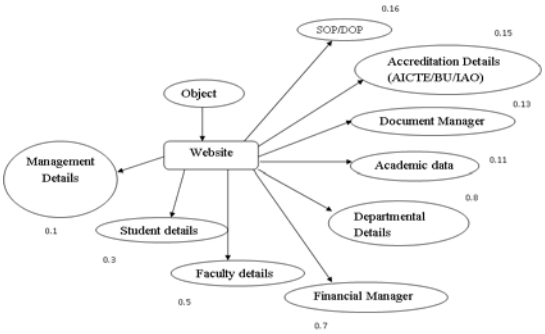

Figure:2 a

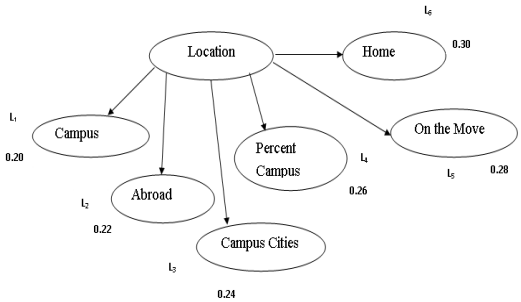

Figure:3 b

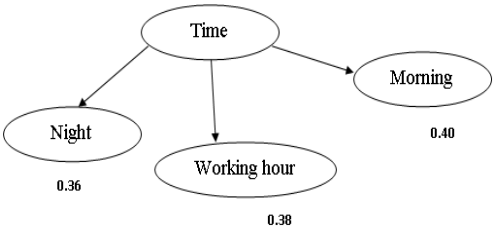

Figure:4 c

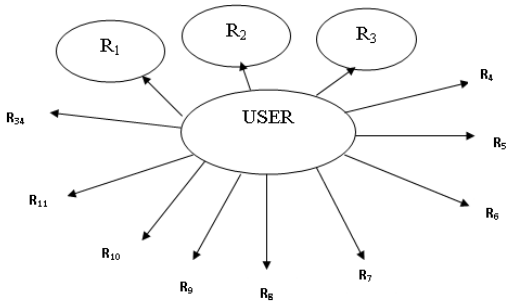

Figure:5 d

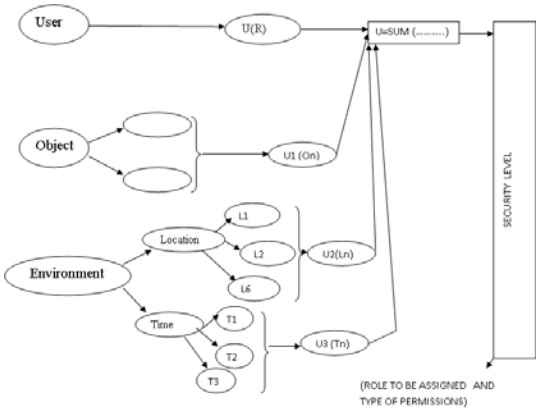

Figure:6 e

The figures above depict the components involved in the system. First, objects accessible by the user is depicted in (a). Second the locations for which the user will be given access is depicted in (b). Third the time of access Considered is depicted in (c). Fourth users associated with various roles which in tern is associated with permissions is depicted in (d). Fifth the relationship between users, object and the associated location is depicted in (e). In (e) the various objects accessible is as in (a).[2][3]

2. APPLICATION OF TRAPEZOIDAL FUNCTION TO THE SYSTEM.

Decision to be made is full access(H), RS(M), access Denied(L). When input is username and password in relation to location.

Table:1 crispest values for username password and location

	L_1	L_2	L_3	L_4	L_5	L_6
1	H	H	H	H	M	M
0	L	L	L	L	L	L

Rules of the crisp decision

$L_1H=0.20$ $L_4H=0.26$
$L_2H=0.22$ $L_5M=0.28$

$L_3H=0.23$ $L_6M=0.30$

Trapezoidal membership function of location

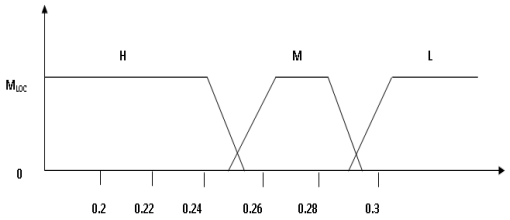

Figure:7 Membership Function For Location

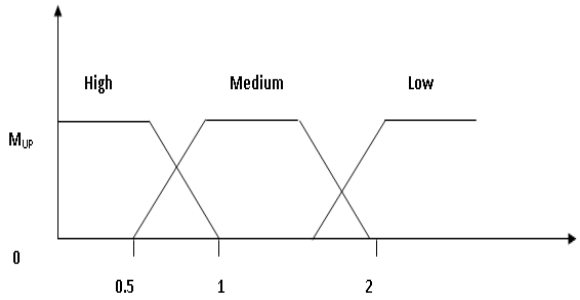

Figure:8 Membership Function Of Username And Password

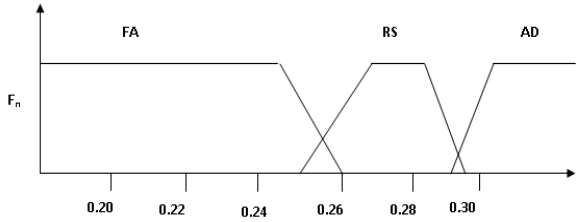

Figure:9 Membership function decision making

$F_n=\{FA, RS, AD\}$

$M_{Loc}=0.26$ and UP=1

$M_{Loc}=\{M_L=0, M_M=0.26, M_H=0\}$

$M_{UP}=\{M_L=0, M_M=1, M_H=1\}$

Table:2 Crisp set values for Decision making

	L_1	L_2	L_3	L_4	L_5	L_6
UP1	0	0	0	0	1	0
0	0	0	0	0	0	0

$F_n=\{H,M\}$

$F_n=\{0,0,0,0,1,0\}$

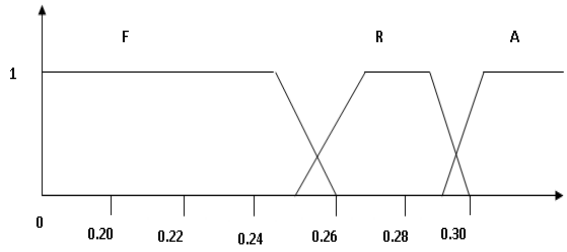

Figure:10 Membership Function For Crispset

Decision from the above example considered is $F_n=\{0,0,0,0,1,0\}$

Decision using the centroid method is

$$FD=\frac{\Sigma M_{Fn}}{\Sigma M_F}=\frac{ML+M+MM+M+ML+L}{ML+MM+ML}$$

$$FD=\frac{0+0.20+0+0.22+0+0.24+1+0.26+0+0.28+0+0.30}{0+0+0+0+1+0}$$

FD=Full access(H).

The decision arrived is depicted by FD for this relationship of username/password and location.

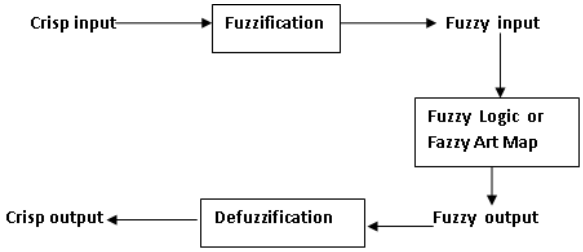

Figure:11 The Fuzzy Logic Process

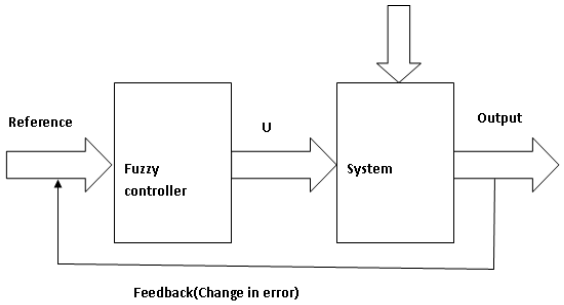

Figure:12 Fuzzy Control System

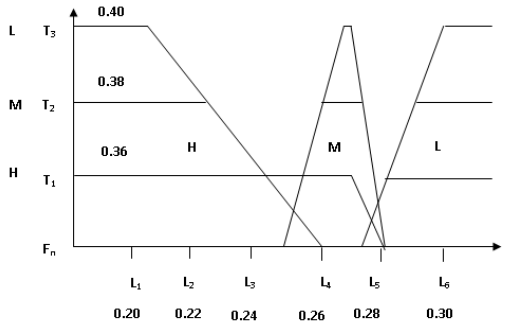

Figure:13 Decision to be made is to assign the role

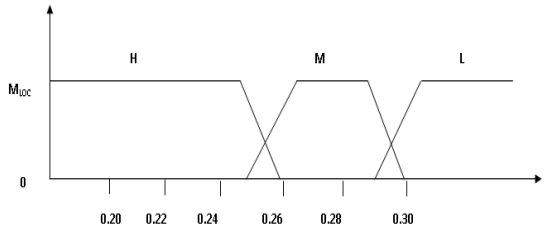

Figure:14 Trapezoidal Member function of Location.

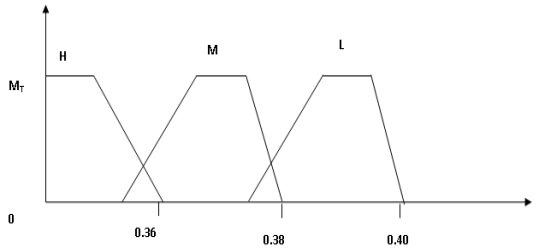

Figure:15 Trapezoidal Member function of Time

Membership function decision
F_n={H, M L}
M_{Loc}=0.26 and T=T_1
F_n={0, 0, 0, 0,1, 0}
Decision using the centroid method
FD=R_5

Table:3 Crispset Values For Time And Location

	L_1	L_2	L_3	L_4	L_5	L_6
T_1	H	H	H	H	M	M
T_2	H	H	H	H	M	M
T_3	M	M	M	M	M	M

Time/Loc=Role	Time/Loc=Role	Time/Loc=Role
T_1L_1=0.38/0.20=0.42	T_2L_1=0.36/0.20=0.42	T_3L_1=0.40/0.20=0.42
T_1L_2=0.38/0.22=0.42	T_2L_2=0.36/0.22=0.42	T_3L_2=0.40/0.22=0.42
T_1L_3=0.38/0.24=0.42	T_2L_3=0.36/0.24=0.42	T_3L_3=0.40/0.24=0.42
T_1L_4=0.38/0.26=0.42	T_2L_4=0.36/0.26=0.42	T_3L_4=0.40/0.26=0.42
T_1L_5=0.38/0.28=0.50	T_2L_5=0.36/0.28=0.50	T_3L_5=0.40/0.28=0.50
T_1L_6=0.38/0.30=0.50	T_2L_6=0.36/0.30=0.50	T_3L_6=0.40/0.30=0.50

Table:4 Crisp Set Values For The Assignment Of Roles

Time T_1		Time T_2		Time T_3	
0.42	R_1=Professor	0.58	R_9=Professor	R_{17}	0.74
0.44	R_2=Associate Professor	0.60	R_{10}=Associate Professor	R_{18}	0.76
0.46	R_3=Assistant Professor	0.62	R_{11}=Assistant Professor	R_{19}	0.78
048	R_4=Teaching Assistant	0.64	R_{12}=Teaching Assistant	R_{20}	0.80
0.50	R_5=Professor Restricted	0.66	R_{13}=Professor Restricted	R_{21}	0.82
0.52	R_6=Associate Professor	0.68	R_{14}=Associate Professor	R_{22}	0.84

	Restricted		Restricted		
0.54	R_7=Assistant Professor Restricted	0.70	R_{15}=Assistant Professor Restricted	R_{23}	0.86
0.56	R_8=Teaching Assistant Restricted	0.72	R_{16}=Teaching Assistant Restricted	R_{24}	0.88

According to the value that is got in FD the role as depicted in the above table is arrived at. The time and location is taken into consideration to arrive at the assignment of the role.[3][4]

Again if a relationship between the role and the type of documents are taken into consideration then by repeating the above process for the same the documents associated can be found out. The type of documents considered in the system are listed below.

Top secret documents

Classified documents

Private Documents

Departmental Documents

Public Documents

and decision for the location and role. Departmental and Public documents

TS	95-100	H
C	90-94	H
P	80-89	H
D	70-79	H
P	0-69	L

To arrive at the role's access of various documents the same procedure as above is repeated so that the user can be assigned the access to the specific document accessible as per the defined constraints. In the example considered since role 5 has been assigned and the user is accessing information from residence, the out come of the above calculation is to permit him to access departmental and public documents only.

3. CONCLUSION AND FUTURE ENHANCEMENTS

This paper has thrown light on using the concepts of fuzzy logic for the assignment of roles in a wireless network . Since fuzzy logic is a tool used to mitigate risk involved in any assignment of resources or access to resources. It reduces to a large extent intrusions happening from unauthorized users. Apart from the above the paper has suggested a novel way to enhance the role assignment in a context aware environment. It would reduce the overload of loading Intrusion Detection Systems. This system can be used to depict the level of security also as a future enhancement.

References

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Authors Profile

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